

The background of the slide is a photograph of a sunset or sunrise over a vast body of water. The sky is a deep blue with wispy white clouds. A bright, colorful rainbow is visible on the left side of the image, arching over the horizon. The water in the foreground is dark blue with gentle ripples.

Objectives and Requirements of SWOT for Observing the Oceanic Mesoscale Variability

**(based on a workshop held at Scripps Institution of Oceanography,
April 28-May 1, 2008)**

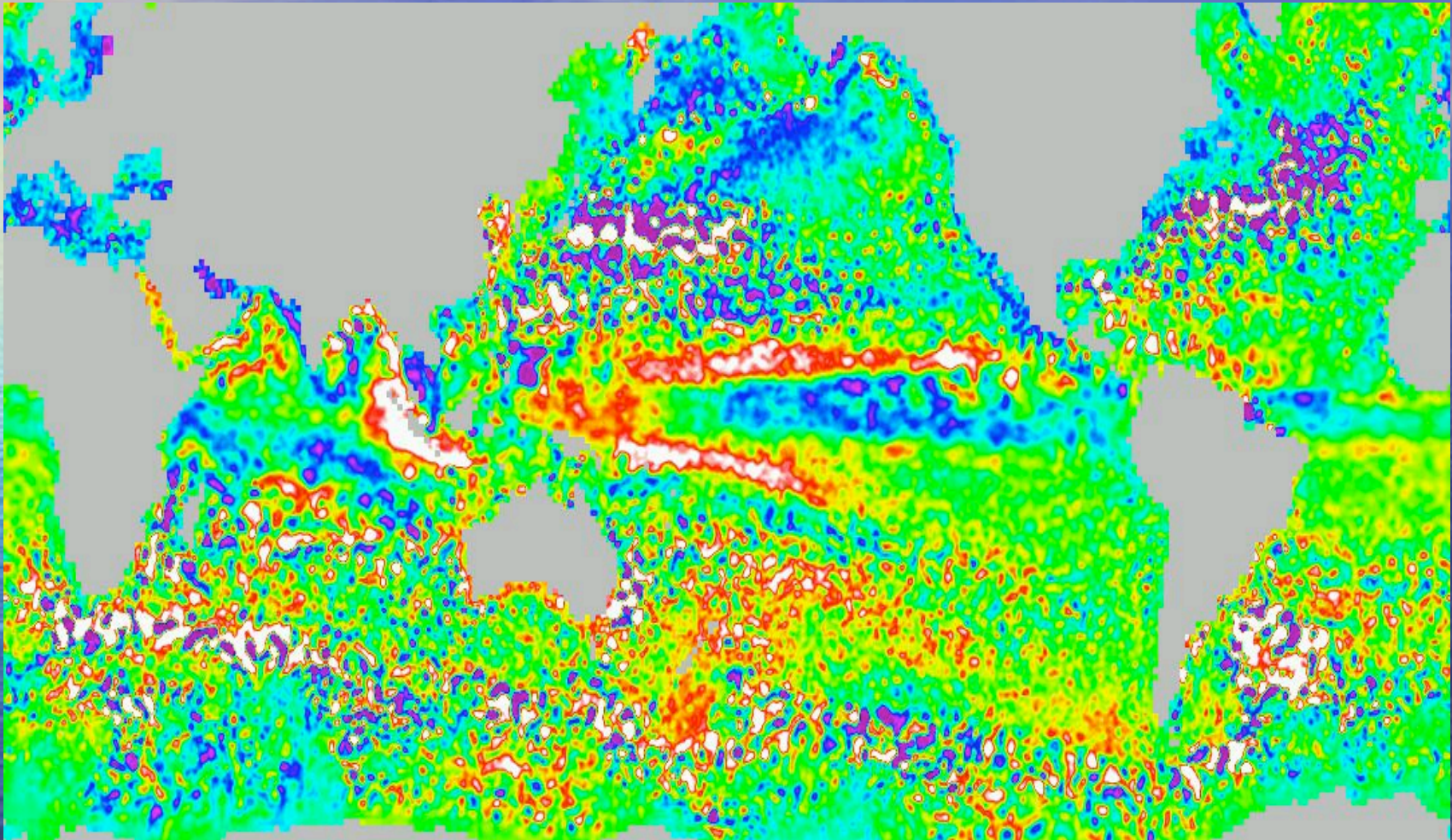
Lee-Lueng Fu

Jet Propulsion Laboratory

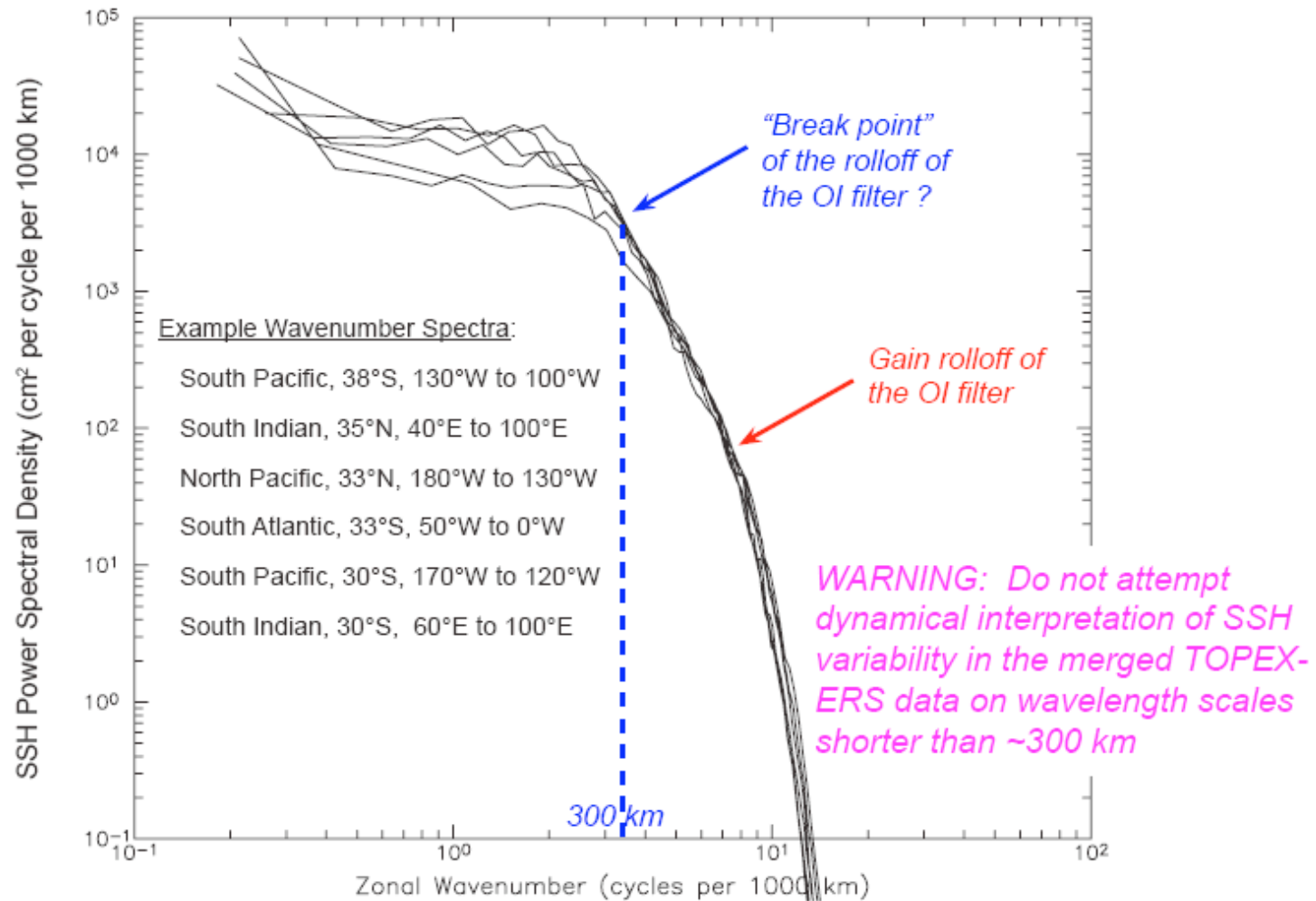
Raffaele Ferrari

MIT

A snapshot of ocean eddies from merged Jason/Envisat data provided by CLS (the best existing data)

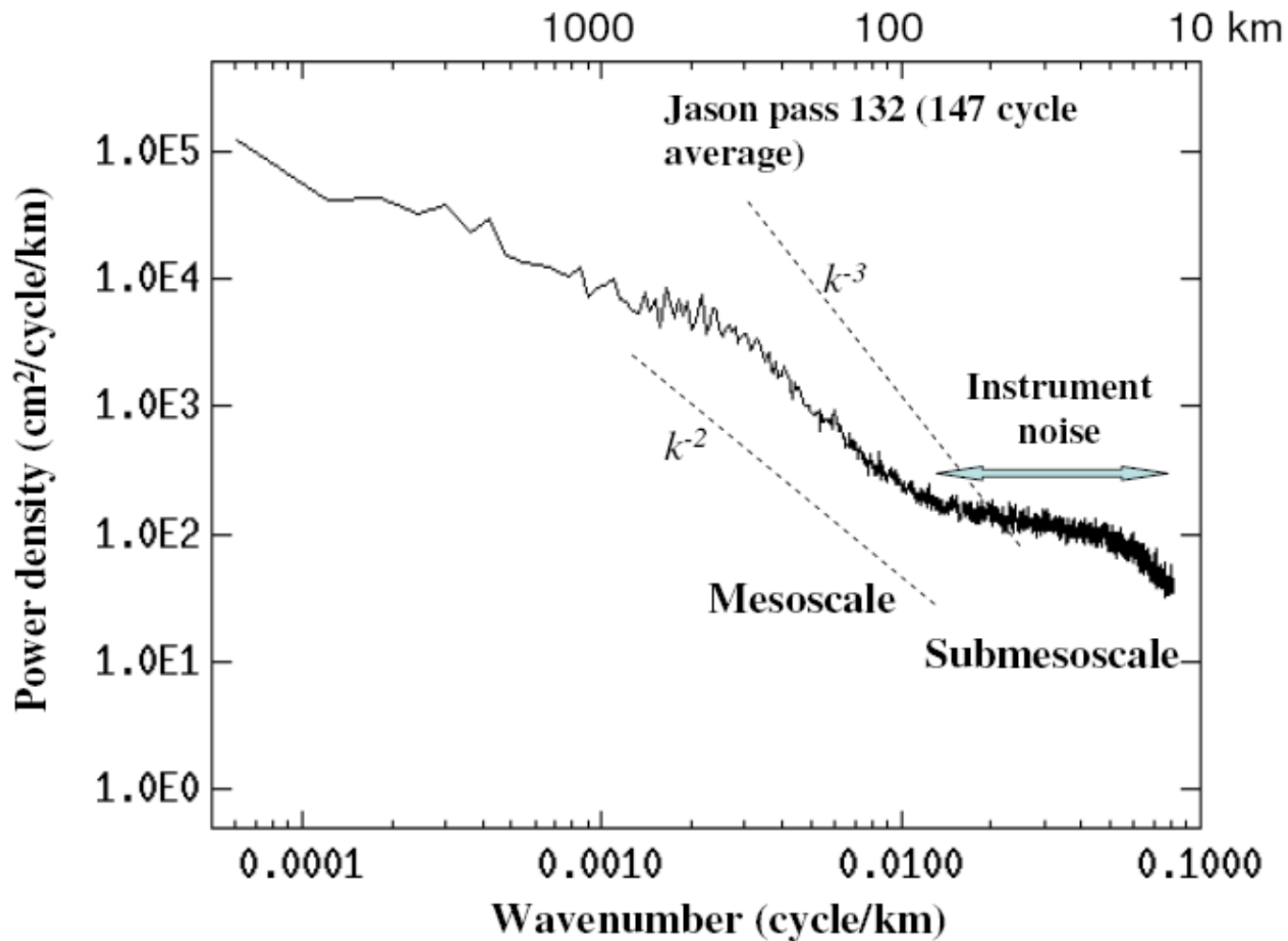


What is the actual resolution of the CLS SSH fields constructed by OI from the merged TOPEX-ERS data?



The oceanic submesoscales have not been well observed

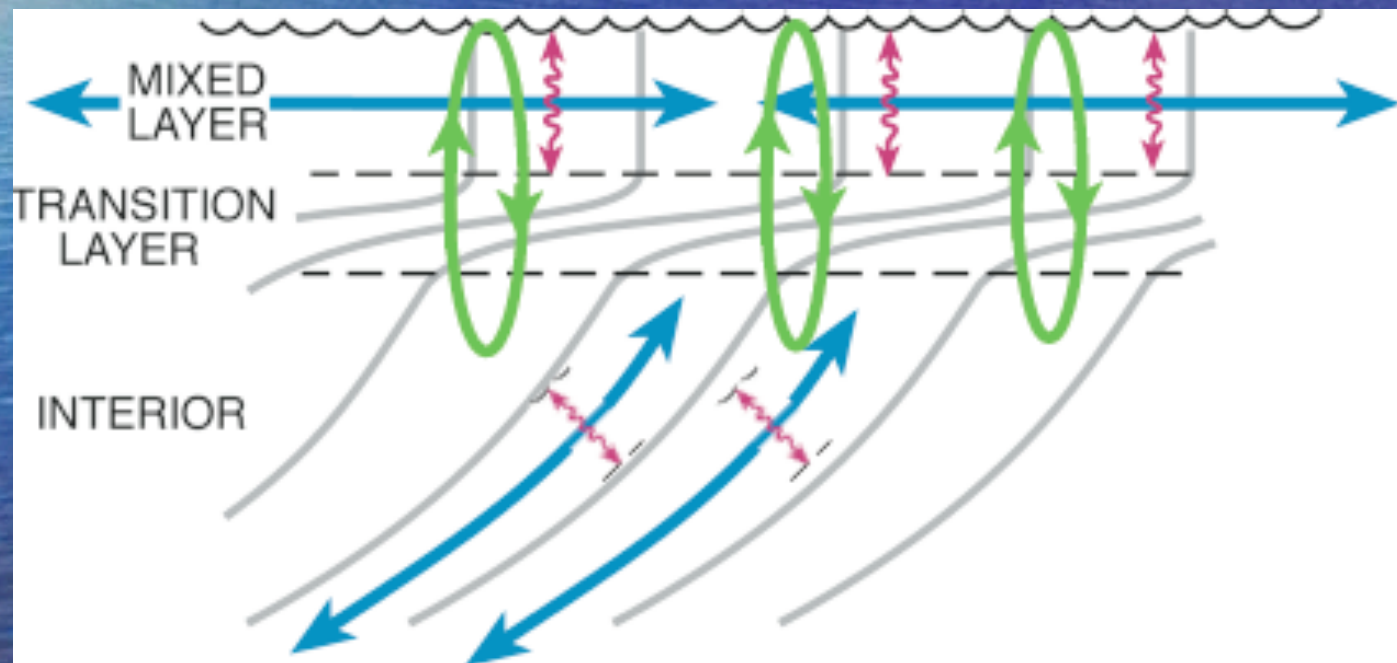
SSH Wavenumber spectrum from Jason altimeter data



The importance of oceanic submesoscales:

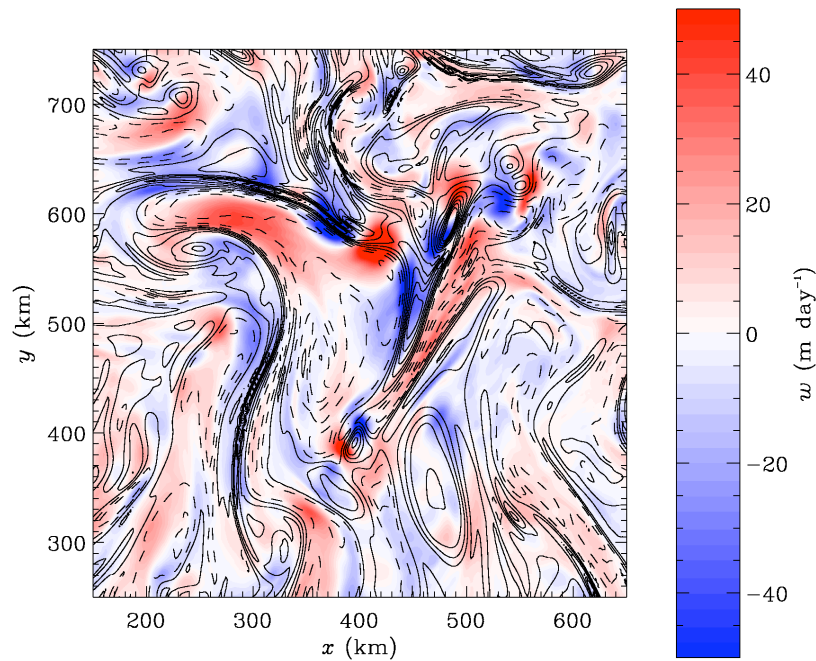
50% of the vertical motion in the world's oceans responsible for heat and CO₂ uptake takes place at the submesoscales

$$\bar{b}_t + \bar{\mathbf{u}} \cdot \nabla \bar{\mathbf{b}} = - \underbrace{\nabla_H \cdot \overline{\mathbf{u}'_H \mathbf{b}'}}_{\text{mesoscale}} - \underbrace{\partial_z \overline{w' \mathbf{b}'}}_{\text{submesoscale}} + \underbrace{\partial_z \overline{\kappa \mathbf{b}'_z}}_{\text{boundary layer}}$$

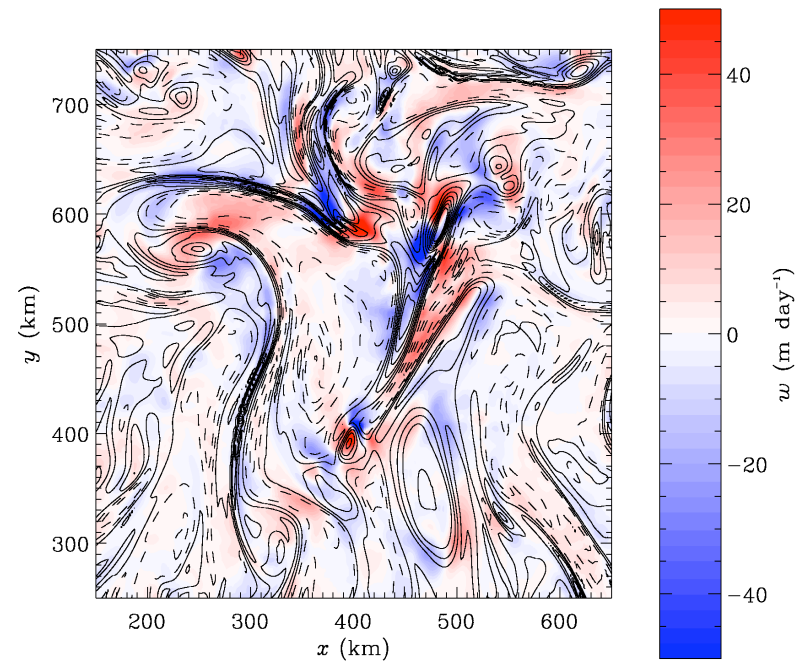


Feasibility of estimating the vertical velocity of the upper ocean from SSH measurement

Simulated W by an OGCM

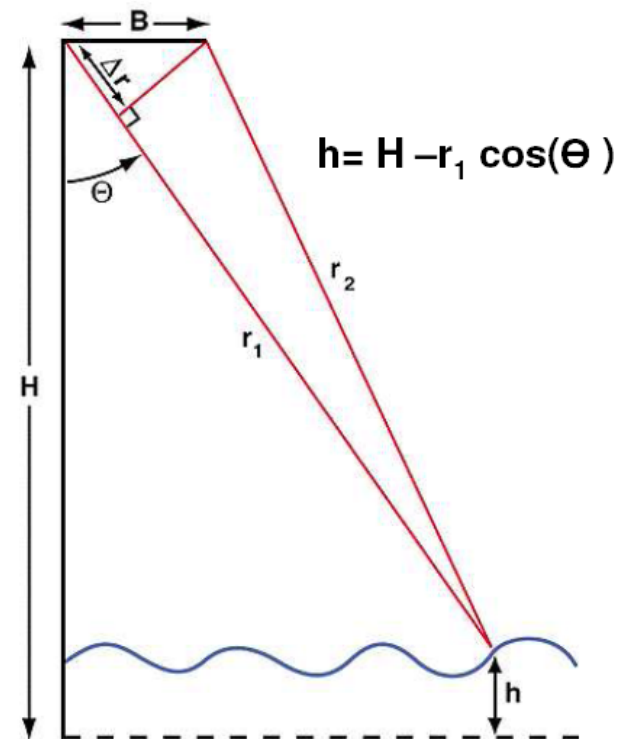
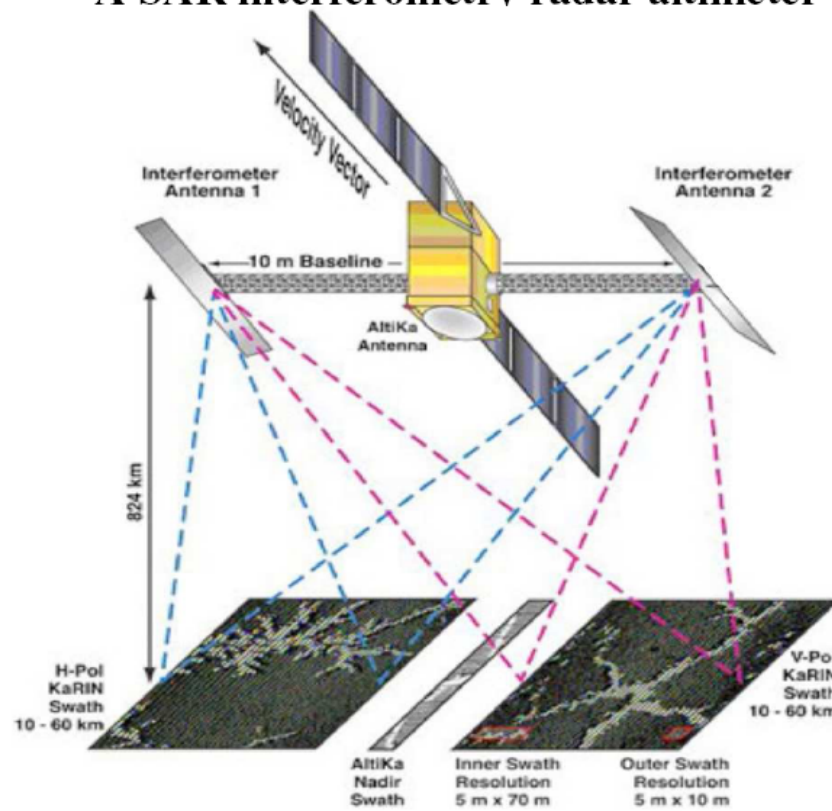


Reconstructed W from SSH

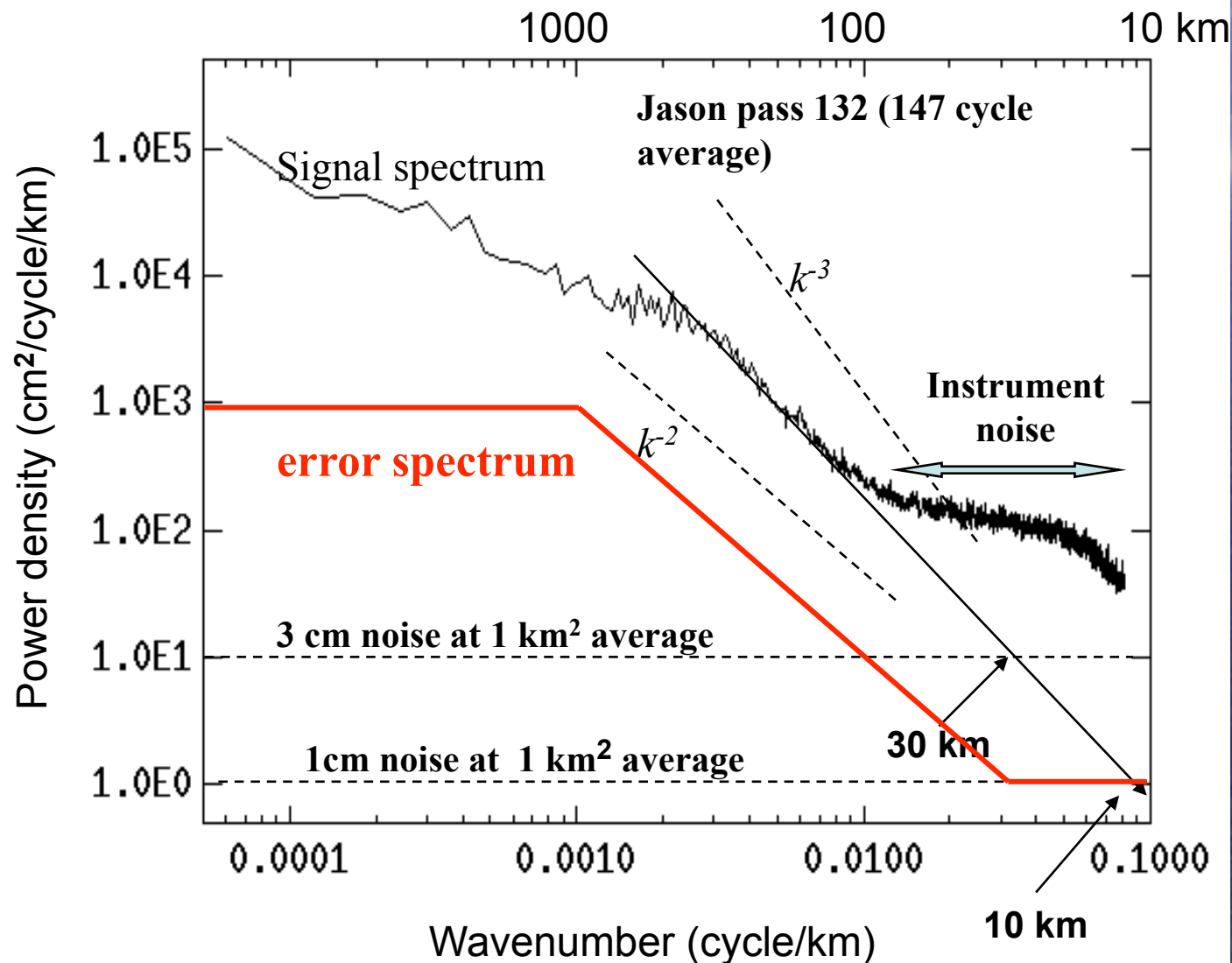


Contours are relative vorticity

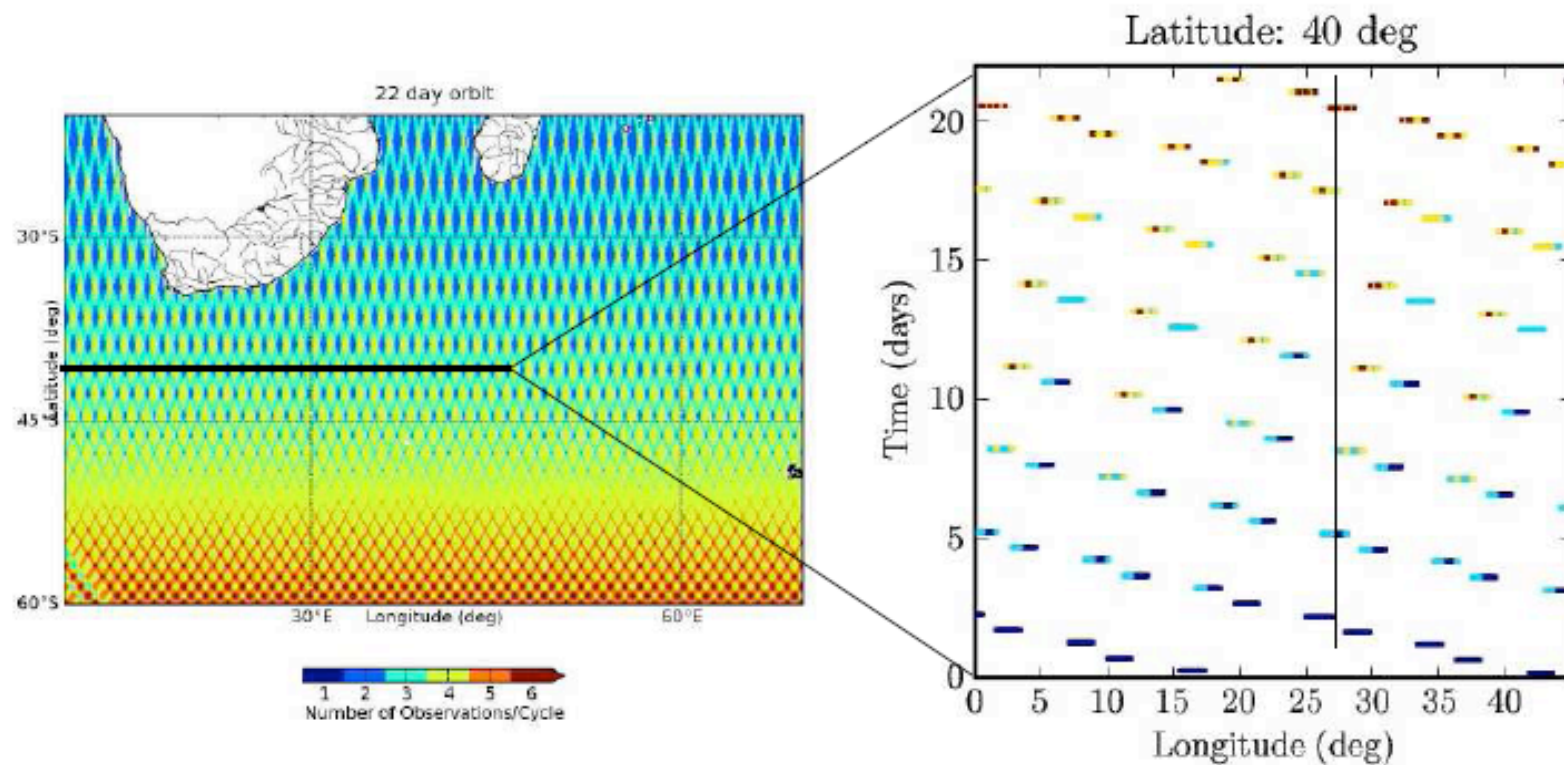
A SAR interferometry radar altimeter



SWOT SSH error spectral requirement (to resolve signals down to 10 km wavelength)



SWOT Temporal Sampling



*Temporal sampling is irregular
and location dependent.*

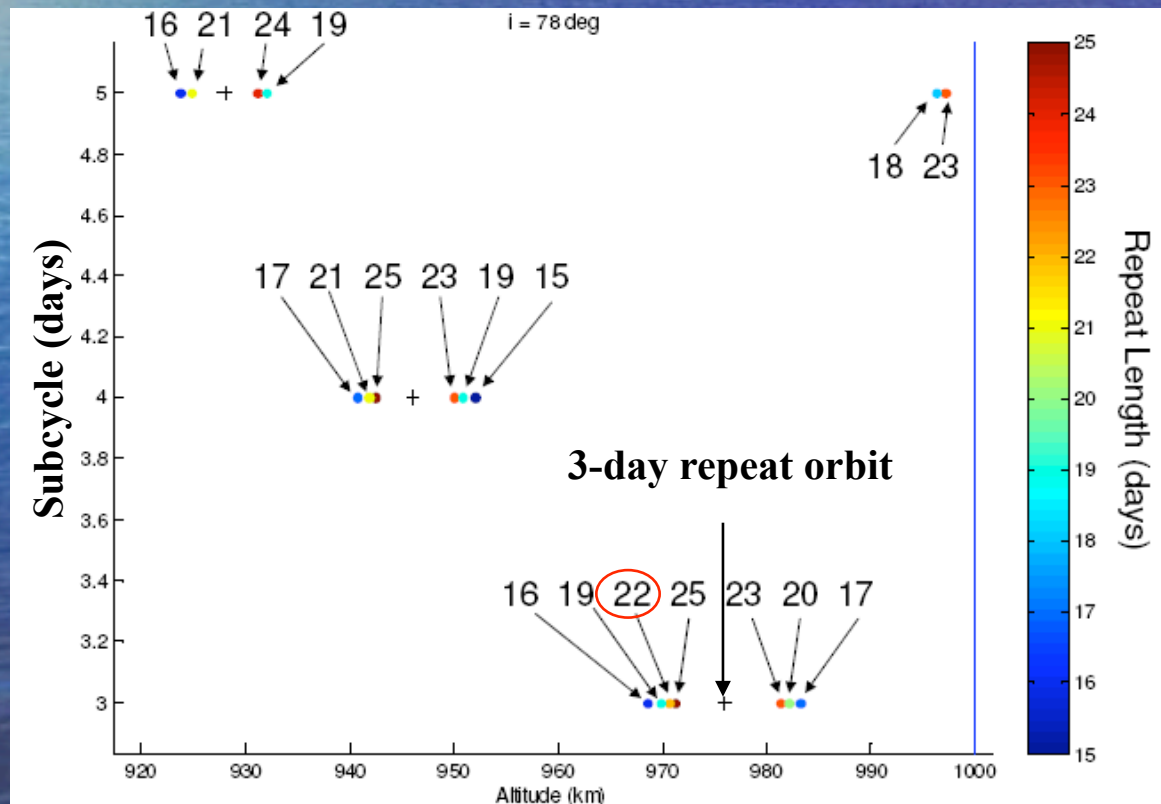
1st 2nd 3rd 4th

Selection of orbit with a desirable subcycle

There was a consensus among the workshop participants for the need of a special experiment of limited duration in which the repeat period is reduced to achieve higher sampling rates for studying the temporal variability of submesoscale processes, especially in coastal zones.

A family of orbits with an inclination of 78 degrees.

A 22-day orbit with a 3-day subcycle can be easily adjusted from an altitude of 970 km to 976 km to get into a 3-day repeat orbit.



Recommendations

- SSH measurement performance of 1 cm noise at 1 km x 1 km averaging is essential for resolving submesoscale features at wavelengths from 10-30 km, depending on the location. Systematic errors should be at least one order of magnitude less than signals at wavelengths longer than 30 km.
- A candidate orbit emerges with the following characteristics: 78 degree inclination, 22-day repeat period with a 3-day subcycle, 970.6 km altitude. This orbit meets the following requirements: cover all the major rivers of the world; minimize tidal aliasing effects; have a subcycle for resolving high-frequency signals with an adequate spatial coverage.

A 3D rendering of the Surface Water and Ocean Topography (SWOT) satellite in orbit above Earth. The satellite is a rectangular box with two large, dark blue solar panel arrays extending from its sides. A long, thin boom extends from the front of the satellite, ending in a small, yellow, rectangular instrument package. The Earth below is shown with green landmasses and blue oceans, with white clouds scattered across the surface. The background is a dark blue space with small white stars.

SWOT

Surface Water & Ocean Topography

Observing global
ocean eddies and
water elevations of
rivers and lakes